

What is claimed is:

1. A liquid crystal device comprising:

a liquid crystal layer (50) disposed between a pair of substrates (20) facing each other; and

inorganic alignment layers (36, 42) disposed on a surface of a liquid crystal layer side of the pair of the substrates;

wherein the range of average pre-tilt angle  $\theta$  of liquid crystal molecules 50a in the liquid crystal layer is  $5 \text{ degrees} \leq \theta \leq 20 \text{ degrees}$ ; and

twist angle  $\phi$  of the liquid crystal molecules (50a) in the liquid crystal layer, cell gap  $d$ , and helical pitch  $P$  of the liquid crystal molecules in the liquid crystal layer satisfy the relationship of  $(0.6 / 360) \phi < d/P < (1.4 / 360) \phi$ .

2. A liquid crystal device according to claim 1, wherein:

the inorganic alignment layers (36, 42) are made of two layers of oblique evaporation layers (36a, 36b) which have columnar structures of an inorganic material slanting in different directions;

azimuth angle directions of the slanting direction of the columnar structures of the inorganic material forming both oblique evaporation layers are different inside the plane of the substrate.

3. A liquid crystal device comprising:

a liquid crystal layer (50) disposed between a pair of substrates (20) facing each other;

inorganic alignment layers (36, 42) disposed on a surface of a liquid crystal layer side of the pair of the substrates;

wherein the range of average pre-tilt angle  $\theta$  of liquid crystal molecules 50a of the liquid crystal layer is  $\theta > 20$  degrees; and

twist angle  $\phi$  of the liquid crystal molecules (50a) of the liquid crystal layer, cell gap  $d$ , and helical pitch  $P$  of the liquid crystal molecules of the liquid crystal layer satisfy the relationship of  $(0.8 / 360) \phi < d/P < (1.6 / 360) \phi$ .

4. A liquid crystal device according to claim 3, wherein the alignment layers are made of oblique evaporation layer (36a, 36b) which are columnar structure of inorganic material slanting in different directions.

5. A liquid crystal device according to claim 1 or 3, wherein the alignment layers are oblique evaporation layers made of silicon oxide.

6. A projection display device, provided with a liquid crystal device according to claim 1 or 3, comprising:

a light source for emitting light;

the liquid crystal device which modulates the light emitted from the light source;

and

a magnifying projection optical system which magnifies the light modulated by the liquid crystal device and projects the light on a projection plane.

7. A liquid crystal device comprising:

a liquid crystal layer (50) disposed between a pair of substrates (20) facing each other;

inorganic alignment layers (36, 42) disposed on a surface of a liquid crystal layer side of the pair of the substrates, and having the gap section (80) comprising a first inorganic oblique evaporation layer (36a) and a second inorganic oblique evaporation layer (36b) formed in an area close to the gap section (80) and on the first inorganic oblique evaporation layer (36a);

an underlayer of at least one of the inorganic alignment layers (36, 42) having gap section (80);

wherein the first and the second inorganic oblique evaporation layers (36a, 36b) are made of slant columnar structure of inorganic material; and

wherein azimuth angle directions of slanting direction of columnar structure of inorganic material constructing both the first and the second oblique evaporation layers are different inside the plane of the substrate.

8. A liquid crystal device comprising:

a liquid crystal layer (50) disposed between a pair of substrates (20) facing each other;

a plurality of pixel electrodes disposed in a matrix, a plurality of switching devices which drive the plurality of the pixel electrode, a plurality of data lines (6a) and a plurality of scanning lines (3a) connected respectively to the plurality of the switching devices are provided on either one of the pair of substrates;

facing electrodes provided on the other substrate;

inorganic alignment layers (36, 42) provided respectively on the surface of the liquid crystal side of the pair of substrates;

an underlayer of at least either one of an inorganic alignment layer on the side of which the switching device is provided has a gap section (80) on its surface;

the inorganic alignment layers (36, 42) formed on the underlayer having the gap section (80), comprising a first inorganic oblique evaporation layer (36a) and a second inorganic oblique evaporation layer (36b) formed in an area close to the gap section (80) and on the first inorganic oblique evaporation layer (36a);

the first and the second inorganic oblique evaporation layers (36a, 36b) comprise slanted columnar structures of an inorganic material;

azimuth angle directions of slanting directions of columnar structures of inorganic materials constructing both the first and the second oblique evaporation layers are different inside the plane of the substrate.

9. A liquid crystal device according to claim 7 or 8, wherein azimuth angles of slanting directions of columnar structures of an inorganic material constituting both the first and the second oblique evaporation layers (36a, 36b) differ by nearly 90 degrees.

10. A liquid crystal device according to claim 7 or 8, wherein the thickness of the first inorganic oblique evaporation layer (36a) is in the range of 5 nm to 16 nm, and the thickness of the second organic oblique evaporation layer (36b) is in the range of 10 nm to 40 nm.

11. A liquid crystal device according to claim 7 or 8, wherein pre-tilt angle  $\theta_p$  of liquid crystal molecules of the liquid crystal layer is in the range of 5 to 15 degrees.

12. A liquid crystal device according to claim 7 or 8, wherein the inorganic

alignment layers (36, 42) are oblique evaporation layers made of silicon oxide.

13. A manufacturing method for a substrate for a liquid crystal device by oblique evaporation of an inorganic material on an underlayer having a gap section on the surface formed on the substrate so as to form the inorganic alignment layers, comprising the steps of:

a first oblique evaporation step by unidirectional oblique evaporation of the inorganic material on the substrate on which the underlayer having the gap section is formed on the surface of the substrate so as to form the first inorganic oblique evaporation layer 36a;

a second oblique evaporation step by oblique evaporation of the inorganic material from at least a different azimuth angle inside the substrate from the oblique evaporation direction of the inorganic material in the first oblique evaporation step so as to form the second oblique evaporation layer 36b in an area close to the gap section and on the first inorganic oblique evaporation layer.

14. A manufacturing method for a substrate for a liquid crystal device, according to claim 13, wherein the azimuth angle of the oblique evaporation direction ( $S_A$ ) of the inorganic material in the first oblique evaporation step and the azimuth angle of the oblique evaporation direction ( $S_B$ ) of the inorganic material in the second oblique evaporation step differ by nearly 90 degrees.

15. A manufacturing method of a substrate for a liquid crystal device according to claim 13, wherein:

deposition angle ( $\theta_1$ ) between the oblique evaporation direction of the

inorganic material in the first oblique evaporation step and the substrate is in the range of 5 to 10 degrees;

deposition angle ( $\theta_2$ ) between the oblique evaporation direction of the inorganic material in the second oblique evaporation step and the substrate is in the range of 25 to 30 degrees.

16. A manufacturing method for a substrate for a liquid crystal device, according to claim 13, wherein the oblique evaporation direction ( $S_A$ ,  $S_B$ ) is selected according to a construction and disposition of the gap section (80) formed on the surface of the underlayer in the oblique evaporation of inorganic material in at least one of the first oblique evaporation step and the second oblique evaporation step.

17. A manufacturing method for a the substrate for a liquid crystal device, according to claim 13, wherein:

the thickness of the inorganic oblique evaporation layer formed in the first oblique evaporation step is in the range of 5 nm to 16 nm; and

the thickness of the inorganic oblique evaporation layer formed in the second oblique evaporation step is in the range of 10 nm to 40 nm.

18. A manufacturing method for a substrate for a liquid crystal device, according to claim 13, wherein the inorganic material is silicon oxide.

19. A projection display device, provided with a liquid crystal device according to claim 7 or 8, comprising:

a light source for emitting light;

the liquid crystal device which modulates the light emitted from the light source;  
and

a magnifying projection optical system which magnifies the light modulated by  
the liquid crystal device and projects the light on a projection plane.